ENVIRONMENTAL IMPACT REPORT

FOR

SKEENA-KITIMAT 287 kV TRANSMISSION LINE

FORESTRY STUDIES

FOR

B.C. HYDRO

PREPARED BY

HUGH HAMILTON LIMITED

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April 16, 1990

Project # 89-792

B.C. Hydro and Power Authority
Environmental Resources
1312 - 808 Nelson Street
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File # 2404-200.0(1)

Attention: Mr. Mark Walmsley

Dear Sir:

Re: Skeena/Kitimat 287 kV Transmission Line, Forestry Review

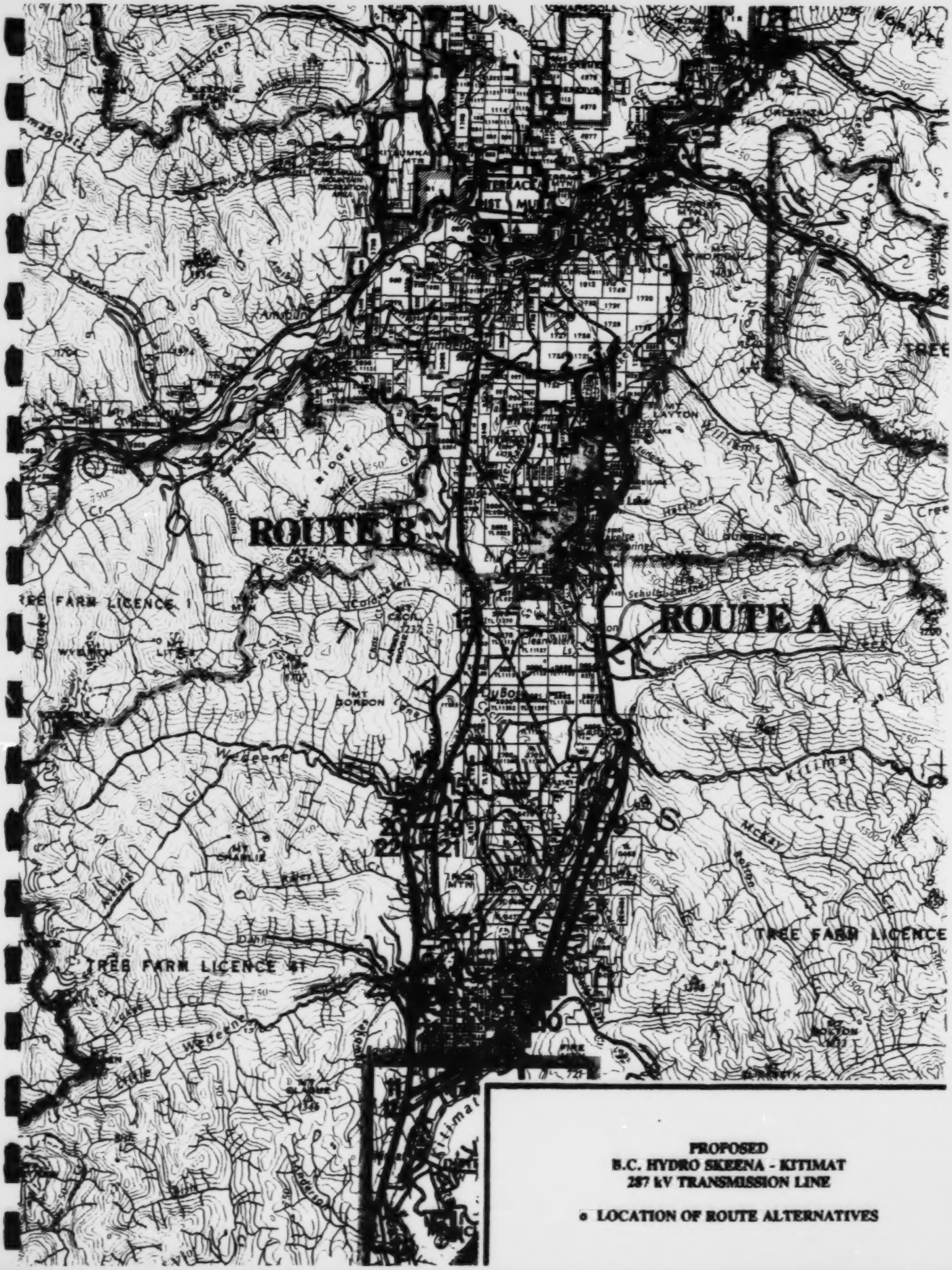
In fulfilment of your instructions dated 16 November 1989 to carry out a Forestry Review of the proposed Skeena/Kitimat 287 kV transmission line, we enclose herewith 20 copies of our report.

We would be pleased to answer any questions which may arise from this report.

Yours truly,
HUGH HAMILTON LIMITED

E.A.H. Hamilton, R.P.F.

EAH/lw
enclosure



PROPOSED
B.C. HYDRO SKEENA - KITIMAT
287 kV TRANSMISSION LINE

o LOCATION OF ROUTE ALTERNATIVES

91-04907/

EXECUTIVE SUMMARY

B.C. Hydro is conducting multi-disciplinary environmental studies for the proposed Skeena-Kitimat 287 kV transmission line. This report covers the forestry aspects of these studies.

The proposed transmission routes transgress the wider and generally flat valley comprising the lower reaches of the Lakelse, Kitimat, Wedeene and Little Wedeene Rivers. Due to heavy harvesting on Old Temporary Tenures over the past 30 years, the valley supports approximately 70% immature managed stands. Furthermore, due to this harvesting, the entire area is well developed by roads.

The objectives of the forestry studies are to provide input into a multi-disciplinary route selection group. This is achieved by mapping and evaluating the forest stands along each major route, or route alternative, and by determining the extent of impact on forest land use, access and social implications.

After gathering pertinent data, a four day field trip was made to Terrace to carry out ground inspections, helicopter reconnaissance and to meet with Ministry of Forests and industry officers.

In view of the fact that transmission rights-of-way transect the forest and to a large extent remove the productive land from forest production in perpetuity, a brief description and history of the forests is provided.

The impacts of transmission lines on the forest resources are described in detail with particular emphasis on the total loss of productive forest lands. In view of the importance of understanding why the loss of land and yield (growth) are so important, considerable time is devoted to demonstrating the source of land loss and the extent of yield loss.

The total length, area and yield lost on routes A and B are as follows:

	A	B	Difference
Length (km)	56.3	47.1	9.2
Area Loss (ha)	236.2	301.5	65.3
Yield Loss (m^3/ha/yr)	1 256.73	1 959.77	703.04

Despite a shorter length of route B, the impact on forest resources is significantly greater on this route. The economic loss from route B is estimated at $472,400 per year. The loss of persons, based on Statistics Canada data is estimated at 2.25 person per year from route B.

Mature stands comprise only 19.9% of route A and 25.9% of route B. The high degree of access to both routes allow for full recovery of mature values.

There is substantial investment in immature stands. This report uses $1,000 per ha for stands receiving only basic silviculture treatment and $2,000 per ha where intensive silviculture is used. Immature values are shown below:

	Total ha	Total investment
Route A	165.3	$173 600
Route B	210.9	$221 400
Difference	45.6	$ 47 800

The proposals for double circuiting are discussed briefly. Although only an additional 2 meters of land is used, route B is more heavily impacted than route A due to the preponderance of medium site classes along the total width of the right-of-way. This suggests that even if double lining is considered there would still be less impact on forestry resources by using route A. Route A remains therefore the preferred route.

A section is devoted to discussing alternative route options within both route A and route B. A number of alternatives on route A were considered, however, the original route (2,3,6,6,8,10,12) remains the preferred route. With respect to route B, the original route (1,13,15,16,24,27,2) is still the preferred route, though a potential route (15-23) on the east side of the Wedeene River on Iron Mountain has a number of benefits and should be studied in more detail.

In view of the importance of mitigating the impacts caused by a transmission right-of-way, a section is devoted to reviewing mitigative measures. This is especially important on those lands which are cleared outside the legal right-of-way. We consider that it is possible to use these lands even though the crop may not be the preceived or conventional crop. It is stressed that most of the impacts to forestry resources, other than the loss of the land base, can be mitigated with suitable liaison and pre-planning.

The general conclusion of this report is that route B inflicts more severe impacts on a land base that is already being depleted from other uses. Consequently, it is strongly recommended that route A be adopted as the preferred route.

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1.0 INTRODUCTION

B.C. Hydro is studying routes for a proposed 287 kV transmission line between the Skeena Substation near Terrace and the Kitimat Substation. Multi-disciplinary environmental studies have been initiated as part of the overall assessment program for this project. This report focuses on the forestry impacts.

The study area for the proposed transmission line covers a relatively flat and open valley system which lies between Terrace and Kitimat. This valley system includes the major drainages of Lakelse Lake and Lakelse River, the Lower Kitimat River and the lower reaches of the Wedeene and Little Wedeene Rivers.

The lands through which the proposed routes would pass are primarily productive forest lands. Approximately 70% of the study area is within the Kitimat Provincial Forest which was established in 1983. Lands on both sides of the Kitimat Forest are held under Tree Farm Licence (TFL) 41. The northern quarter of the study area, surrounding Lakelse Lake is within the Skeena Supply Block of the Kalum Timber Supply Area (TSA) and includes private lands, park areas and federal lands (airport). The extreme south part of the study area includes the District of Kitimat incorporating the urban areas and forest lands.

The greater part of the study area has been logged over in the past. Accordingly the land supports primarily immature plantations or naturally stocked immature stands. The volume of mature timber suitable for harvesting is therefore of a lesser consideration than the values in immature stands.

The valley system is transgressed by a utility corridor on the east comprising Highway 25, the existing B.C. Hydro 287 kV transmission line and natural gas pipelines. The Canadian National Railway transgresses the western side of the study area. There is good access throughout the area provided by various logging road systems.

2.0 GUIDELINES TO ENVIRONMENTAL STUDIES

2.1 Terms of Reference

The objective of the environmental studies is to provide input into a multi-disciplinary route selection group which will determine the optimum route for a 287 kV transmission line between Skeena Substation and Kitimat Substation.

The Terms of Reference for forestry studies are:

1. Determine and map the location of forest cover types and evaluate the extent of forest utilization and relative values of forest stands. Describe and map major vegetation types on an ecological basis.

2. Using information from the land use/socio-economic consultant regarding forest tenure, determine the nature and extent of impact on forest land use (e.g. access, loss of growing sites, etc.).

3. Assess the data; evaluate and map constraints to development of the transmission line and suggest mitigation measures to lessen the impact.

4. Participate in public meetings, multi-disciplinary evaluation and the selection of the optimum transmission line alignment.

5. Provide a report covering the above material.

2.2 Scope and Limitations

The proposed transmission line options will pass through productive forest land over almost their entire length. There are few non-productive areas such as rock, swamps or non-commercial forest areas. The routes pass through a mosaic of forest types, principally immature stands, and through a number of different tenures and cutting authorities.

A. Timber Types

It is not within the scope of this study to identify or categorize the individual forest types which may be impacted. This would of course be necessary in final route determination and centre line location. This report therefore concentrates on defining the larger classes of forest cover such as mature and immature, and in defining areas of Good, Medium and Poor productivity site classes within these mature and immature areas.

B. Tenures

The transmission routes transgress Supply Blocks within TSA's, special Provincial Forests, and a Tree Farm Licence (TFL). This report identifies the major administrative forest units and tenures, but it is not within the scope of this study to identify individual cutting authorities, cutting permits, or other short term rights to harvest.

C. Stand Identification

Within the immature stands there are boundaries between age classes, stand types and treatment classes which may be only a few hectares in extent. Although there may be differing values applicable to the various immature forest types depending on age, species, and investment in treatment, it is not within the scope of this study to identify and quantify detail down to a level of individual stands. Immature stands have therefore been identified only by leading species such as hemlock, or spruce and by productivity class (Good, Medium, Poor, and Low).

D. Roads

The entire study area is well developed by a Provincial Highway (25), public roads, mail, logging roads, secondary logging roads, spurs and trails. Many roads are not, however, indicated on the current map bases. Accordingly, only main haul roads which may have a bearing on transmission line design are identified and mapped.

E. Logged Areas

The proposed transmission routes cross some areas which have been logged in recent years. For the purpose of this report all logged areas have been treated as immature since planting is normally carried out within thee (3) years. However, those areas on the proposed routes which have been logged within the last three (3) years (recent logging) are identified on attached maps.

3.0 METHODOLOGY

The method of approach in conducting the forestry studies falls into four (4) principal phases:

1. Data gathering
2. Field inspection
3. Data analysis
4. Report

3.1 Data Gathering

This phase was comprised of collecting inventory data, maps and yield information and meeting with representatives of the Ministry of Forests (Ministry) and forest companies.

Meetings were arranged during the week of November 12-17 with officers of the Ministry of Forests, Kalum Forest District in Terrace, and with representatives of Skeena Sawmills Ltd. a division of Eurocan Pulp and Paper Co. Ltd. and Skeena Cellulose Ltd. The officers of the Kalum District office are responsible for administering all forestry activities in the Kalum TSA, which includes the Kitimat Provincial Forest, the Skeena Provincial Forest, and TFL 41 which is licensed to Eurocan Pulp and Paper Co. Ltd.

Skeena Sawmills Ltd. and Skeena Cellulose Ltd. hold licenses within the areas administered by the Ministry and have obligations under these licences.

The names and titles of all persons contacted and interviewed are provided in Appendix 1. Data provided by these sources is listed in Appendix 2.

3.2 Field Inspection

The objective of the field inspection was to examine the general location of the two principal route options, to identify potential impacts, and determine options for mitigation.

The field inspection was carried out initially by a helicopter overview flight arranged by B.C. Hydro. The full extent of each route was viewed and important features were examined in detail. However, adverse weather conditions precluded detailed examination in some sectors.

Ground inspection was carried out on November 13 by 4x4 vehicle. The proposed routes were followed and areas of significance or potential impact were visited. The vehicle trip was conducted in conjunction with John Dumbrell (Urban Systems Ltd.), Geordie Howe (Arcas Consulting Archaeologists Ltd.) and Bruce Haggerstone (Durante Kreuk Ltd.).

3.3 Data Analysis

Loss of productive forest land is singularly the most important impact of a transmission line on forest resources. Therefore, the analysis of maps and inventory data supplied by the Ministry of Forests (Ministry) and licensees focused on quantifying the loss of productive

forest land and the resultant loss of yield, or annual allowable cut (AAC). The extent of mature forests, immature forests, and non-productive land was also quantified.

Examination of aerial photos and photos taken during ground travel were used to identify locations of potential impacts on access, cut-off lands and other forestry impacts.

Data derived from these studies was then plotted onto a single 1:50 000 base map provided by B.C. Hydro. These maps show the following features:

1. Major administrative units.
2. Mature and immature forest zones.
3. Cut-off areas: Areas where harvesting might be affected due to transmission line location.
4. Major road crossings.
5. Sample plot or research plot locations.
6. Recent logged areas (Last 3 years).

Tables providing analysis of route impacts on the productive forest land base, and resultant permanent losses in yield are provided.

3.4 Report

The forestry studies report was prepared using the data assembled above. It provides the background to the project, details of the evaluation, suggestions for mitigative measures, review of multi-disciplinary meetings, and general recommendations regarding route options available to review committees.

Residual old growth stands along the Wedeene River near 25 km on Route B.

Extensive immature stands south of Lakelse Lake (in background) showing patch work of stands showing varying silviculture activity.

4.0 DESCRIPTION OF THE FOREST

4.1 The Coastal Forest

The lowland forests of the Terrace-Kitimat valley, in which the study area is located, are located totally in the Coastal Western Hemlock (CWH) biogeoclimatic zone. The mature forest stands in this zone are characterized by western hemlock (Tsuga heterophylla), sitka spruce (Picea sitchensis), balsam (Abies amabilis), western red cedar (Thuja plicata), and lodgepole pine (Pinus contorta). Other conifer species and deciduous species found in the study area and vicinity are listed in Appendix 3.

The old growth hemlock forests which covered the study area have been harvested and replaced by natural or planted stands. Within the study area there are now only remnants of the old growth stands located mainly along the rivers and creeks, on steeper slopes and in planned reserve areas.

The immature stands which have replaced the old growth forests comprise mainly healthy stands of hemlock, balsam and spruce. Generally, the forest sites on the lowlands, terraces and benches are of high productivity. For this reason the Ministry of Forests, and the Tree Farm Licence owner have spent time and money in planting and tending the stands.

4.2 Brief Background History

It may well be asked why almost the entire expanse of the valley is now occupied by immature stands, and why there is not more old growth left in the area.

The valley has always been highly accessible both to road and rail, and at the same time to tidewater. The flat valley which supported heavy stands of predominantly hemlock and spruce attracted the attention of early lumbermen who took out Special Timber Licences (Old Temporary Tenures) over the greater part of what is now the Kitimat Provincial Forest. This form of tenure gave the owner the right to harvest all the mature timber in those licences and consequently by the mid-1900's most of the mature stands had been liquidated and remaining timber values have been cut out since. The last of these tenures is now owned by Eurocan Pulp and Paper Co. Ltd. (Skeena Sawmills) and will expire in 1992.

The forest lands to the east and west of the original Special Timber Licences were designated as Tree Farm Licence 41 in 1970. Those parts of TFL 41 along the valley were cut first and consequently these areas too support healthy immature stands.

The areas originally covered by Special Timber Licences now in the Kitimat Forest have been managed by the Forest Service. Cut over sites were re-stocked by natural regeneration or by planting and in 1983 approximately 21 000 ha comprising deleted Special Timber Licences and Crown land were put into the Kitimat Provincial Forest and are now administered within the broader Kalum Timber Supply Area by the Ministry, Kalum Forest District.

Route A from 2 km looking east to 4 km. Typical plateau benchland supporting mature and immature stands of lodgepole pine and hemlock. Note recently logged area.

Lakelse Hotsprings looking north at 14 km. This photo shows a combination of timbered upland slopes, deciduous wetlands and non-productive wetlands along the existing right-of-way.

4.3 Terrain and Soils

The wide flat valley which stretches from Terrace south to Kitimat comprises a series of gravel and glacial till benchlands which overlay marine clays. The lower slopes of the mountains are comprised either of bedrock, or shoulders of gravel such as those providing aggregates within Kitimat.

Typical kettle-holes are found on the gravel benches from Onion Lake west to the foothills of the Kitimat mountain ranges. To the south of the Onion Lake flats, the gravel benchlands have been eroded through to heavy glacial tills and marine clays. It is these unstable clays which are found along the west side of the Wedeene River southwards to the Little Wedeene River. Similar clays are found near Highway 25 on the north-east corner of Lakelse Lake.

In general, the finer soils including silts, sand and gravels south of Lakelse provide sites of high productive capacity. Some of the coarser gravels in benchlands north of Lakelse which retain less moisture support somewhat poorer stands of timber. However, in general the combination of a warm wet climate throughout most of the year with good soils provides highly productive forest sites.

Forest sites with the quality of those in the study area, are very limited in the Kalum TSA. Detailed description of soils and terrain is provided by Denny Maynard, a member of the study team.

5.0 IMPACTS OF TRANSMISSION LINES

5.1 Discussion

Transmission line construction through forest areas incurs a number of impacts on the forest land base and on activities conducted on the lands through which the transmission right-of-way passes. Although some of the impacts may be mitigated, the most severe impact on the forest resources is the removal of the productive forest land base in perpetuity. This is singularly the most severe impact on the forest resources. The loss of productive land contributes to the ongoing alienation of productive forest land from many sources and is a major concern in a community based on the forest industry.

The loss of annual volume growth has ramifications in both woods jobs and sawmill jobs. This is a major consideration in the Terrace-Kitimat area where the timber industry is a major contributor to the local economy. Therefore, any measures by which the amount of alienated land can be reduced, must be seriously considered.

The Kalum TSA covers a wide area along coastal mountains and valleys. However, valley bottom lands which provide the most productive and most easily managed areas constitute a very small percentage of the total productive area of the TSA. The valley bottom lands in the Skeena-Kitimat study area constitute a significant portion of these limited bottom lands.

Unspaced hemlock-balsam stands approximately 20 years old. These stands are typical of immature stands along Route B from End Lake south to The Wedeene River (13 km to 24 km).

Upland areas west of Clearwater on Route B at 10 km. Photo shows advanced immature in foreground, recent logging and residual old growth in background.

There are a number of impacts to the forest land base created by transmission lines, the most important of which are:

1. loss of the productive forest land base;
2. loss of mature volumes;
3. loss of investment in immature stands; and
4. cut-off lands due to transmission line location.

5.2 Description of Transmission Line Impacts

The direct impacts created by transmission lines and the mitigative measures which may be applied are shown in Table 1 on the following page.

A brief description of each of the direct impacts is given below since reference will be made in the text to their potential impacts.

1. Loss of Productive Forest Land Base

The loss of productive forest land base directly impacts on the volume yield of the forest, and therefore, on the calculated Annual Allowable Cut (AAC). Since the AAC indirectly affects jobs, the comparison of loss of forest land capability between two potential routes is the most important factor in route determination from the forestry point of view.

TABLE 1

DESCRIPTION OF TRANSMISSION LINE IMPACTS ON FOREST RESOURCES

	1. Direct Impacts	Possible Mitigative Measures
A.	Permanent loss of productive land base on legal right-of-way and extended clearing.	Reduce land use; use routes with lower productivity.
B.	Loss of mature values, reserve areas.	Planned harvesting and recovery of stumpage values.
C.	Loss of immature values.	No direct mitigation.
D.	Cut-off lands affecting harvest of adjacent stands.	Planned routing and access provision.
E.	Logging access constraints.	Higher line heights over existing and proposed main access can be negotiated.
F.	Fringe effects; blown down, etc.	Careful access construction ar clearing standards.
G.	Construction access proliferation.	Maximize construction access inside R/W.
H.	Environmental impacts.	Planned routing, uneven edges
I.	Chemical brush control on adjacent stands.	Mechanical clearing or controlled chemical treatment
J.	Sample plots, research plots.	Adjustment of alignment or re-establishment of plots.
	2. Indirect Impacts	Mitigative Measures
A.	General proliferation of utility routes.	Consolidation of utility corridors.
B.	Loss of jobs through reduction of AAC.	Line maintenance jobs.
C.	Increase in harvest and access planning procedures.	Consolidation of utility and transportation corridors.

West of Route A at 26 km looking north. Spaced stands in foreground with unspaced stands in background showing cleared cross-country ski trails.

Spaced and pruned stands of hemlock at 26 km near Route A. Stumps from old growth stands show below canopy.

2. Loss of Mature Volumes

The principal areas in which merchantable mature volumes will be lost are on the upland plateau north of Lakelse Lake along Route A and on the rolling forested uplands along Route B from the Clearwater River crossing north to Skeena substation.

Recovery of Crown revenues for stumpage on wood volumes removed from hydro right-of-way are presumed to be equivalent to stumpage recovered from planned harvesting areas in view of the high degree of access and easy clearing on most of the proposed rights-of-way.

It is assumed, however, that there will be full recovery of the merchantable volumes affected by the right-of-way.

3. Loss of Immature Values

The investment in immature stands is estimated to average $1,000.00 per ha for stands treated under basic silviculture and $2,000.00 per ha for intensively treated stands. These average values will vary considerably. They will be high for some naturally established stands, however, the $2,000 per ha is low on the average for stands which have received intensive treatment such as spacing, pruning, brushing and weeding, and supplementary planting. The loss of this investment is a major impact when added to the permanent loss of land base.

Compensation for licence holders for silvicultural improvements impacted by a transmission line is provided in the Forest Act under Section 53.

Potential cut-off stands on Route A south of Kitimat River crossing at 31 km. Stands between proposed right-of-way and existing right-of-way.

Potential cut-off stands in broken terrain south of Little Wedeene River at 37 km on Route B. View looking west up Little Wedeene at alternate 25-27 Route.

4. Cut-off Forest Lands

The construction of a transmission line can affect harvesting from lands on the up-hill side of a right-of-way or on cut-off areas between two rights-of-way by constraining access or harvesting techniques. This is especially the case where transmission lines transgress steep terrain. In severe cases AAC can be directly affected by such constraints. There are three areas of potential cut-off lands along the proposed routes. These are shown on the accompanying 1:50 000 maps as hatched areas.

5. Environmental Impacts

There are a number of less severe environmental impacts which may be caused by a transmission line. For instance, clear cutting close to a transmission line may exacerbate the visual quality of the terrain and cause the Forest Service to disallow cutting.

In addition, harvesting near or above a transmission line might be restricted or constrained by B.C. Hydro or the Ministry where it is considered operations might affect water patterns and induce heavy run-off, thereby affecting the transmission right-of-way.

These situations could occur on those sections shown as cut-off lands and on less steep terrain such as the west side of the Wedeene River. In most cases these situations can be mitigated by appropriate planning.

6. Fringe Effects: Blow Down

The construction of a narrow cleared right-of-way through a forest, especially one which is very straight, provides a corridor for wind and storm damage. The location of a line can also prompt insect attacks, and affect soil hydrology through exposure factors abnormal to the stand.

Consequently, it is considered expedient to reduce these linear impacts whenever practicable.

7. Construction Access Proliferation

Under normal circumstances, access for transmission line construction is built within the right-of-way. However, there are almost always circumstances created by the terrain where access has to be developed outside the right-of-way creating additional impact on the forest land base.

These interactions are most likely to occur in steep terrain and in the vicinity of creek crossings or steep slopes off benchlands.

For these reasons, a route which parallels the existing line (route A) would be preferable to a new opening. However, there are also a large number of logging roads along the entire length of route B which should provide adequate access for construction purposes and minimize access proliferation.

Logging access north of the Little Wedeene River at 36 km on Route B. This picture shows that in this case there will be adequate clearance under the proposed line for both main roads.

8. Logging Access Constraints

The movement of equipment under transmission lines requires a clearance of at least 10 metres. In the past there were problems along the existing transmission line, but increased line heights over established access have eliminated this problem.

Route B transgresses some very active logging areas in which there is existing main access and potential new roads. Although this problem is mitigable, the problem exists, whereas on Route A it will be minimal.

9. Chemical Brush Control

Brush and tree growth control will be required along either route. Route B is shown to have a greater area of productive site which will require brush maintenance. Although mechanical control may be practised on flat areas, it may be necessary to use alternative methods on steeper terrain.

10. Sample Plots, Experimental Plots

Analysis of route locations shows that although there are no experimental plots directly impacted by the tentative route locations, there is significant potential for impact adjacent to Route B especially within TFL 41.

Although sample plots are not large, they not only represent very significant direct investment, but have an inherent value in the data pool for yield determination and silviculture research.

6.0 ASSESSMENT OF IMPACTS

6.1 Discussion

The impact of a hydro transmission right-of-way on forest resources is directly related to its length, width, and site productivity of land it uses. Many of the impacts of transmission line construction on forestry resources described in Table 1 can be avoided or mitigated by suitable action. This section will focus, therefore, on describing and quantifying the five principal impacts (A through E) which can be measured. The assessment, measurement and mapping of these factors are discussed below in the order presented above.

6.2 Permanent Loss of Productive Forest Land Base

6.2.1 Length of Right-of-Way

The total length of the two main route options, A and B, are compared. The section AB (node 12 to 28) south to the Kitimat is common, and will not therefore affect the comparison.

The length of the main options are summarized below in Table 2 and show that route B is 9.26 km shorter than route A.

TABLE 2

LENGTH OF RIGHT-OF-WAY
BY LAND CLASS
(km)

Land Class	Route A	Route B	Route AB
Productive	50.11	41.31	7.90
Non-Productive Forest	0.50	0.59	-
Non-Forest	5.72	1.17	0.11
Total	56.33 km	47.07 km	8.01 km

6.2.2 Right-of-Way Width

The proposed transmission line legal right-of-way widths will be as shown on Table 3 below. The clearing width to ensure security will vary with tree height and ground slope. For 20 metre trees on a new single circuit line, the clearing width would be 35 metres from each side of the centreline. Widths based on 20 metre tree heights are shown in Table 3 below for each configuration.

The clearing outside the legal right-of-way to ensure line security may also be a permanent loss to the forest land base. Although the width of the extra cleared land is dependent on such factors as the slope of the land and tree height, we have assumed a minimum extra clearing width based on the assumption that the land is flat. Since the greater proportion of the proposed right-of-way is relatively flat we believe this assumption is valid in this assessment.

Table 3 below provides details of clearing widths for the three transmission line configurations.

TABLE 3

RIGHT-OF-WAY CLEARING WIDTHS

Right-of-Way Configuration	Legal Width (m)	Total Clearing Width (m)	Hectares per km of Line (ha)
Separate R/W; single	32	70	7.0
Both Circuits on New R/W	55	93	9.3
Double Circuit on Steel Tower	34	70	7.0
R/W Parallels Existing 287 kV	16	23	2.3
R/W Parallels Existing R/W with Pipeline Between	32	51	5.1

The maximum potential loss of productive land for each kilometre of transmission line is shown in Column 3.

* Widths will vary, but for the purposes of this table a typical width based on a 20 m tree height requires the width shown.

6.2.3 Loss of Forest Growth

A. Productive Capacity of the Forest Site

Numerous factors affect the capacity of a site to produce forest growth. These include such factors as terrain, soils, elevation, aspect and climate. For most forest areas in British Columbia, the Ministry, or Tree Farm Licence holders have assigned site classes as a basic measure of site productivity.

Forest sites are generally classed as Good , Medium, Poor or Low based on height criteria for the forest zone or location. The site classes are also assigned growth factors, which express the annual growth (or increment) which one hectare of that site is expected to yield each year. This factor is termed the Mean Annual Increment (MAI).

Two sets of MAI figures were examined for the study area:

A. MAI data for the Kalum TSA supplied by the Inventory Branch, Victoria.

B. MAI data from the North Block of TFL 41 by Eurocan Pulp and Paper Co. Ltd.

It was agreed by the Ministry of Forests in Terrace that MAI figures for TFL 41 would be the most appropriate for the sites within the study area. Although these are higher than the regional average figures, they more closely represent the high sites of the Kitimat Valley.

Accordingly, the MAI figures for coniferous species for TFL 41 are used in this report. The MAI's for deciduous stands have been taken from the Forest Inventory Zone (FIZ) net MAI tables for the Skeena TSA. The MAI's used for leading species are shown in Table 4 on the following page.

TABLE 4

MEAN ANNUAL INCREMENT

(FROM TFL 41, NORTH BLOCK)

Site Class	Species	MAI (m^3/ha/yr)
Good	Hemlock	11.73
	Balsam	10.54
	Spruce	10.89
	Deciduous (All)	9.20
Medium	Hemlock	6.61
	Balsam	6.17
	Spruce	8.53
	Cedar	6.06
	Deciduous (All)	4.30
Poor	Hemlock	3.51
	Balsam	3.21
	Spruce	No Poor Sites
	Cedar	3.99
	Deciduous (All)	3.2
Low*	All Species	1.3

* Low site was not used in TFL 41 so the figure of 1.3 m^3/ha/yr is adopted from an average of Kalum TSA data.

Table 4 demonstrates the loss in growth per year on each hectare of productive forest land. It is evident that in order to mitigate losses to forest yield, right-of-ways should be designed to traverse land with the lowest possible site class wherever possible. In the study area, medium sites supporting hemlock predominate. We believe it is possible to select a route which overall impacts on less productive forest land by using less productive area, by using land of lower productivity, or by using less land.

B. Calculation of Land Losses

The objectives of quantifying land and yield loss are:

A. To determine actual and relative area measurements for Routes A & B.

B. To determine the areas of mature merchantable timber, the area of immature and of non-productive land for Routes A and B.

C. To determine the potential loss of yield for Routes A and B.

In order to achieve the above, Routes A and B were plotted on forest cover maps and the length of right-of-way were digitized by site class, mature timber, immature timber and non-productive lands. In addition, these measurements took into account transmission line width. The above data was compiled to these factors by major administrative units.

Calculations and comparisons were only made for the two major route alternatives. It is assumed that alternative options, or revised segments, would not significantly alter considerations of the two major route comparisons.

Comparative data was not calculated for segment 12-28 (AB) since this is a segment common to both Routes A and B. Comments concerning its location and impacts on forest resources are brought up in following sections.

The loss of land area for the two proposed routes are compared below and show the comparison of legal and total right-of-way clearing.

TABLE 5

SUMMARY OF AREA LOSS BY ROUTE

Land Class	Legal R/W (ha)		Total Clearing (ha)	
	A	B	A	B
Productive Forest	103.7	132.1	212.5	289.2
Non-Productive Forest	0.8	1.9	1.5	4.1
Non-Forest	10.6	3.8	22.2	8.2
Total	115.1	137.8	236.2	301.5

C. Calculation of Yield Losses

The yield losses are derived by applying the MAI figures shown in Table 4 above to each of the forest types measured by site and leading species.

A summary of the loss of forest growth, or annual yield, from the productive forest land base is shown in Table 6 below. For the purpose of this table it is assumed that the total cleared area is permanently removed from the forest land base. Detailed calculations supporting these figures are provided in Appendix 5.

TABLE 6

SUMMARY OF YIELD LOSSES FOR ROUTES A & B
IN m^3/yr

Site Classes	Legal R/W		Total R/W	
	A	B	A	B
Good	114.06	135.99	209.70	309.58
Medium	432.15	699.57	878.19	1 593.07
Poor	77.54	35.62	164.57	57.12
Low	1.95	-	4.27	-
Total	625.70	871.18	1 256.73	1 959.77

The conclusions which may be drawn from Tables 2, 5 and 6 are:

1. Route B (47.07 km) is 9.26 km shorter than Route A (56.33 km), yet the total loss of productive forest land base is 27.6% greater.

2. The loss of yield is 55.9% greater on Route B despite the shorter distance.

The above tables and conclusions demonstrate the importance, when considering forestry impacts, of selecting routes which traverse lands of lower productivity, or which follow existing transportation corridors.

From a practical point of harvesting, some of the lands calculated as productive on route A would never be cut in any event as they are situated between the existing power line and the gas pipe line. Therefore, the total loss of yield for route A has probably been slightly overstated at 1 256.73 m^3 per year.

D. Economic Impact

The losses in yield calculated above will ultimately be reflected in the calculation of the annual allowable cut (AAC). In a study carried out for the Association of B.C. Registered Foresters in 1985 it was shown that for every cubic meter (m^3) lost there would be a direct loss of \$115.00/m^3 and an indirect loss of \$85/m^3 for a total loss of \$200.00/m^3. This would equate to \$225.00 per m^3 at 4% annual inflation by 1989. At this figure one truck of logs would generate \$7,875. The total loss from route B is 1 959.77 m^3 per year, or 60 truck loads. In total economic value this represents \$440,948 per year. Losses from route A would be \$282,764, a difference of \$158,184 per year (See Table 6).

This measure is fairly broad and would be influenced by several factors such as logging costs, transportation distance, milling costs, species and grades. However, as an average, it demonstrates the annual dollar loss to the local economy due to the drain of productive land from the forest area.

Statistics Canada provides details of persons and dollars lost per m^3 of log and lumber lost (produced).

Table 7 below summarizes these statistics.

TABLE 7

ANNUAL YIELD LOSSES EXPRESSED IN PERSONS AND DOLLARS BY ROUTE
STATISTICS CANADA - B.C. COAST 1986

	Person Years		Shipments $		Value-Added $	
	A	B	A	B	A	B
Logging	.54	.84	70,857	110,496	31,130	48,545
Sawmilling	.83	1.41	138,872	216,559	59,445	90,348
TOTAL	1.37	2.25	209,729	327,055	90,575	138,893

(See Appendix 8 for Statistics Canada Data and ABCPF Position Paper Summary)

6.3 Loss of Mature Timber

The clearing of mature timber from the right-of-way may incur the following impacts:

1. Loss of volume to local forest industry.
2. Loss of stumpage revenue to the Crown.
3. Loss of reserve blocks designated for conservation, protection, and multiple use purposes.

However, losses from 1 and 2 can be mitigated by planned harvesting during right-of-way clearing. Minimizing loss to permanent reserve areas can only be achieved by sensitive location selection.

Due to heavy harvesting in past decades, the proportion of mature timber is fairly low. However, where mature timber exists, it is generally in sensitive areas. Locations of mature stands are shown in dark green on the accompanying map at a scale of 1:50 000.

Table 8 below shows the relative area of mature and immature on routes A and B.

TABLE 8

AREA OF MATURE AND IMMATURE
BY ADMINISTRATIVE UNIT IN HECTARES
FOR TOTAL RIGHT-OF-WAY ONLY

UNIT	ROUTE A		ROUTE B	
	Mature	Immature	Mature	Immature
Kitimat Provincial Forest	2.4	75.0	2.5	54.7
Kitimat District Municipality	-	19.0	7.1	10.9
Kalum TSA	17.0	34.2	43.5	42.1
T.F.L.	24.9	19.5	25.1	103.1
Special Timber Licences	2.9	17.6	-	-
Totals	47.2	165.3	78.2	210.8

The mature values on route A comprise stands on plateau lands south of the airport (nodes 1-3), stands on steep slopes east of the existing right-of-way from Lakelse Lake south to the Kitimat River (nodes 7-8) and mature hemlock stands of poor quality on plateau lands east of Onion Lake and south of Lot 2663. Mature stands on route A represent 19.9% of total area loss.

Mature values on route B comprise primarily scattered residual reserve blocks along the total length of the right-of-way, but primarily in TFL 41 and the Kalum TSA units. Special attention must be paid to those mature reserve blocks located on or near the Little Wedeene, the Wedeene River, the Coldwater Creek and Lakelse River. Mature stands on route B represent 25.9% of total area loss.

6.4 Loss of Immature Values

In addition to the removal of productive forest land in perpetuity, a further impact of a transmission line is the removal of immature stands in which there is substantial investment. In the case of the two options under consideration, the preponderance of productive forest land supports immature stands. These stands may be naturally re-stocked stands or planted stands ranging from recently planted areas to stands up to 40 years old. In all these cases investment in the form of site preparation, planting, silviculture surveys, spacing, thinning and pruning may have been carried out.

In general it can be assumed that an average of not less than $1000.00 per ha has been invested in basic forestry work on all immature stands. In the case of stands on which intensive silviculture has been applied (thinning, spacing, pruning) the investment is often $2000.00 or greater. For the purposes of this report, these respective values are used.

Forest cover maps do not identify which immature stands have been intensively treated, however, from field observations along the routes we believe that not more than 5% has been intensively treated, therefore 95% of immature stands are assessed at $1,000.00/ha.

TABLE 9

VALUE OF IMMATURE STANDS

	Total ha	Investment ($)		
		95% basic @ $1000/ha	5% intensive @ $2000/ha	Total Investment
Route A	165.3	157 000	16 600	173 600
Route B	210.9	200 400	21 000	221 400
Difference	45.6 ha	$43 400	$ 4 400	$ 47 800

The above figures support the data previously shown that route B impacts more severely on the forest resources than route A.

6.5 Cut-off Lands

The effect of a transmission line adjacent to steep terrain, or in situations where a new line creates unusable stands between two transportation routes, is to create unusable stands or cut-off lands. Locations where cut-off lands can be expected are shown in hatching on the accompanying 1:50 000 route maps.

It is not possible or reasonable to assess the total area of potential impact at this time since even small shifts in line location can mitigate the problem. Indeed, in most cases, loss of productive land due to cut-off criteria can be avoided, or mitigated, to a great extent.

Along route A the two most severe situations are:

1. Mature stands between diverging lines south of Lot 2663 near 21 km on Schulbuckhand Cr.

2. Mature stands south of the Kitimat River crossing between the diverging lines at 21 km. These stands lie west of node 8 and encompass a steep timbered ridge.

Along route B the principal cut-off areas are:

1. South of the Little Wedeene along the steep sidehill south of node 27. These stands are not high quality or priority harvesting areas.

2. Stands on the alternate B route above the railway on Iron Mountain between nodes 15 to 23.

6.6 Road Access Constraints

The movement of equipment under transmission lines requires a clearance of at least 10 metres. Problems which existed along route A in the past have been corrected. However, it is very important that critical access roads are identified so planning of towers and deflection is taken into account at the outset when this impact is fully mitigable.

The principal roads which cross under the proposed routes have been designated on the 1:50 000 maps accompanying this report. Details of important road crossings have been supplied for TFL 41 by Eurocan Pulp and Paper Co. Ltd. and are exhibited in Appendix 6: Potential Road Impacts.

7.0 PROPOSALS FOR DOUBLE CIRCUITING

7.1 Discussion

In the previous section the impacts of two possible alternative 287 kV transmission lines were discussed. As a result of public input during January and February 1990, the option of double circuiting either route A or B was brought forward. This section examines the forestry impacts of double circuiting on either route A or B.

Double circuiting will require construction of metal towers which will be considerably taller than the wooden pole construction for the 287 kV lines. The extra height will require that the legal right-of-way will be 34 m, rather than 32 m, and that the total right-of-way will remain at 70 m.

We have presumed that if a double circuit were placed on route A, that it would be placed in the location that is proposed for the new 287 kV line. Therefore, the direct comparison is valid. The most effective system would be that a new double circuit be placed where the existing 287 kV line exists. In this case forestry impacts would be minimal.

Table 10 below compares the total losses only using double circuiting configuration with the proposed single 287 kV configuration.

TABLE 10

COMPARISON OF IMPACT BY TYPE OF CIRCUIT

Circuit Type	Total Area (ha) A	Total Area (ha) B	Total MAI (m^3/yr) A	Total MAI (m^3/yr) B
Single	236.27	301.49	1,256.73	1,981.77
Double	243.34	310.06	1,262.93	2,029.74
% Increase	3.0	2.8	.5	2.4

The above table shows that the percentage increase in loss of productive forest land is very close between route A and B, but the percentage increase in loss of yield (MAI) is far greater on route B than on route A. This can be expected due to the high proportion of productive land on route B. Table 10 shows that double circuiting on route B incurs significantly increased impacts on the forest resources.

Double circuiting on route A could cause a significantly greater impact on the forest resources than the single new 287 kV line due to some steep slopes. If the existing 287 kV line were subsequently abandonded it would not free any land for forestry, since the available land would be cut off from production activities.

It is not within the terms of reference of this study to debate the relative merits of single versus double circuiting. However, the position from the point of view of forestry resources is that route A, whether single or double, has far less impact on forestry resources and remains the prefered route.

8.0 ALTERNATIVE ROUTES

8.1 Discussion

A number of route alternatives were identified in a study team workshop on December 8, 1989, and confirmed in a letter to workshop attendees on December 14, 1989.

This section reviews the alternative route options and draws conclusions with respect to each option, or group of options. The comparison of the two primary routes established in Section 6.0 is are not changed by the conclusion reached in this examination.

In assessing the alternatives no field work was possible, therefore mosaics, aerial photos, and forest cover maps were examined in order to arrive at the conclusions which follow (refer to the key map for node numbers).

A letter from the District Manager, Terrace advising of the Ministry of Forests views on the alternatives is included in Appendix 6.

8.2 Route A Alternatives

Nodes 2-7

The original route 2-3-6-7 remains the preferred route since it impacts the least on productive forest land. Although in the assessment we have shown the lowland wet areas as productive, they would not in our view provide a forest crop in the long run.

Looking south along Kitimat River at 36 km on Route A. This photo shows strip between the existing transmission line and the pipeline. This zone would be well utilized by a new line as productive stands would be severely constrained from harvesting.

The route 2-5-6 is, we believe, a reasonable alternative to 2-3-6 although the forest sites between 2-5 are better than those on 2-3. There would also be a fairly severe visual impact on traffic moving north along Lakelse Lake. In view of the lower impact of route 2-3-6 on forest land, this route is preferred.

We can see no advantage in lengthening the impact on forest land by considering 3-4-7.

In conclusion, we would support 2-5-6 only if fisheries impacts on Sockeye Cr. precluded doubling the line from 3 to 6.

Nodes 8-10

This alternative suggests a route (8,9,10) along the uplands east of the existing line, 8-10.

We can understand the reasons for considering this alternative, but we believe the added impact on the land base is not warranted considering the availability of the existing utility corridor.

The greater part of 8-10 which parallels the existing route is adjacent to, or within, existing utility right-of-ways. Although the forest cover shows these lands as productive, the fact is that the greater proportion of the flat land areas, and especially those between the pipeline and the existing transmission line will never produce a harvestable crop. An added right-of-way will therefore impact only very slightly if it follows the existing lines.

The eastern route 9-10 traverses uplands which have been harvested and now generally support good immature stands. Since this route would be a single new line, it would have the maximum impact on the land base (70 m wide, or 7 ha per km of land).

For the above reasons we would urge that the original location, 8-10, be followed.

Nodes 10-11 & 10-12

The impacts on the forest land are approximately equal whether south or north of the existing line. If engineering, terrain or other considerations have well founded arguments, we would support whichever made the most practical sense.

8.3 Route B Alternatives

Node 13-15 & 13-16

The western route, (13-14-16), while appearing to have some advantages over 13-15, presents some severe problems:

1. 13-14-16 would appear to impact both Cecil Creek and Wolf Creeks more severely than 13-15.

2. 13-14-16 would pass through reserve timber areas, especially on Wolf Creek, which we feel should not be broken up. There is already all too little mature timber on flat lands along creeks.

3. This option will present more potential impact on cut-off lands and road access development.

The letter from the District Manager (January 17, 1990) in Appendix 6 should be studied.

Node 15-23

This proposed route alternative on the east side of the Wedeene River and east of the railway line on Iron Mountain is a very important alternative to route 16-18-22-24. This route will impact on two merchantable timber cut blocks, but planned harvesting will precede right-of-way construction. The forest sites are equally as good as those on the west, but are generally harder to manage due to the rocky and broken terrain. There will be approximately one (1) km of forest which will be cut-off from harvesting due to a right-of-way. However, this one factor is generally outweighed by the generally lower overall impacts on route 15-23-24.

The Ministry consider that a route along Iron Mountain above the railway would create a wider inoperable strip than just the right-of-way. Skeena Sawmills Ltd. concluded that this alternative traverses lower site and less manageable terrain and is therefore preferred. Certainly the ground is more stable on route 15-23-24, and provided the line were well up the hill above the railway it would appear to be a better alternative than 15-22-24.

Calculations show the alternative route impacts less area but incurs a slightly higher loss of yield. Table 11 below shows these differences.

TABLE 11

DIFFERENCE IN IMPACT BETWEEN
ALTERNATIVE (IRON MOUNTAIN) ROUTE AND PROPOSED ROUTE B

(DIFFERENCE OF 15-17-24 FROM 15-16-24)

Total Length (km)	-0.99
Total Area (ha)	-6.93
Total MAI (m^3/yr)	+22.39

In view of the slight differences, yet potentially significant impacts, these alternatives should be studied more closely.

However, we conclude that 15-23 with a crossing to 24 is a preferable route to 15-16-18-20-22-24.

Node 16-24

The present proposed route on the west side of the Wedeene River is shown very close to the existing main road. If this route is selected, the actual location should be 200-300 m west of the line as presently shown on the map.

All the stands on this route are immature stands, some of which have received special silvicultural treatment. Sites are mostly shown as Medium quality, but due to the

flat terrain and good access, the stands can be closely managed.

It is our conclusion that route 15-23 would impact less on the forest resources than 16-24 and consequently is the preferred route.

Nodes 24-27

The three alternatives have been suggested in order to secure a better crossing of the Little Wedeene River.

Alternative 24-25-27 traverses immature stands on flat benchland north of the Little Wedeene and immature stands in highly broken terrain south of the river. Due to the steepness of the gulleys from 25-27, there could be considerable proliferation of right-of-way access with damage to immature values. Further, depending on the exact location, there could also be cut-off forests above the right-of-way. We do not believe that the extra amount of land used in this alternative is necessary in order to achieve a better river crossing.

Two major road systems follow the north side of the Little Wedeene River, one along the river, and the other up on the benchland. In all three route options there should be ample deflection from towers to the benchland on the south bank of the river to avoid impact on the roads. This is not a major issue.

There is, however, a large reserve block of mature timber immediately north of 27. This reserve block straddles both sides of the Little Wedeene River and is one of the

few bottomland reserves of mature timber. Route 24-26-27 would cut through the middle of this old growth reserve.

Accordingly, we remain in favour of route 24-27 since this location would pass by the eastern side of the timber reserve without impacting heavily on the old growth timber. Deflection over the two main haul roads (Branch 200 and 300) is good using this option.

9.0 MITIGATIVE MEASURES

9.1 Loss of the Productive Forest Land Base

This section discusses the ways by which the impacts of transmission line construction on forestry resources can be reduced or eliminated. In other regions of the province it is possible to maintain agricultural activities under power lines, or the growing of Christmas trees. It is not possible, however, to consider such practices in the Terrace area and accordingly, the assumption was made in section 5.1 that the lands cleared for the Skeena-Kitimat transmission line would be lost in perpetuity to the production of forest products.

This is certainly true for the legal right-of-way. There have been suggestions that the safety clearing outside the legal right-of-way could be used for forest production provided the height of the crop does not create a danger to the transmission line.

This concept has not to our knowledge been practised in British Columbia, other than with Christmas trees but it does warrant discussion. The use of small trees for poles, posts, and rails is becoming more common in forest areas close to major cities or agricultural areas. It is also possible that pulp harvesting could be considered in the safety areas.

Without detailed policies or specifications provided by B.C. Hydro, it is not possible to determine what the saving on the forest resources would be. However, assuming that trees would be allowed to grow to 20 m in height, the loss in yield shown in section 6.2 might be reduced by approximately 1/3. Where soils are stable and

stands are well tended we believe some form of productive stand management could be practised.

Since there is a greater proportion of safety clearing associated with route B there would be a correspondingly greater saving on route B over route A if such measures were to provide a practical solution.

In our view the development of this form of mitigation is not sufficiently advanced at this point in time to bring it into the consideration of route impacts. Therefore, the impacts shown in Tables 5 and 6 reflecting the permanent losses to the forest land base will be retained in this report.

9.2 Loss of Mature Volume

In section 6.3 the loss of mature timber was discussed. The principal losses of mature timber as shown can be almost completely mitigated or eliminated.

1. Loss of volume to local forest industry.
   Adequate advance planning and appropriate clearing procedures should provide local loggers with work and local forest industries with the logs. We believe 100% recovery should be achieved on both routes A and B.

2. Loss of stumpage revenue to the Crown
   In view of the good access to most sections of routes A and B, we believe the Crown should receive stumpage values consistent with the Small Business sales sold in tributary areas.

3. Loss of reserve blocks

Many of the reserved timber areas have been left for conservation measures, wildlife refuges, etc. There will be some loss to this resource, but as we have shown with noes 24-27 it is possible to avoid or reduce impacts by sensitive location practice.

Mature stands represent 19.9% of route A and 24.9% of route B.

9.3 Loss of Immature Lands

Section 6.4 outlines the impacts on immature stands. The loss of investment is the principal impact, since the loss of yield is covered in section 9.1 above.

Table 7 shows higher overall loss of immature stands on route B, but the loss of immature as a percentage of total area loss is 70.0% on both routes.

Detailed field studies and sensitive location selection would reduce direct investment dollars and yield losses.

If the proposals suggested in section 9.1 become a reality, then impacts to immature stands may be reduced by approximately 33% and the investments could be at least partially saved.

9.4 Cut-off Land Mitigation

Cut-off lands have been described in section 6.5 but in this section attention is devoted to primarily mature timber which may be lost to harvesting.

Cut-off lands and timber cut-off form harvesting can be mitigated by advanced planning as follows:

1. Suitable advance notice to allow potential cut-off lands to be harvested.

2. Provision in tower location for appropriate road access location.

3. Right-of-way alignment to minimize potential for cut-off lands (viz node 8).

4. Consideration in right-of-way alignment for future crop evee if existing mature is harvested in accordance with 1. above.

9.5 Road Access Constraints

The planning of transmission line spans over existing and potential road access is critical to uninterrupted industrial activity. Suitable advanced notice to Ministry or industrial licensees will ensure input to facilitate appropriate design.

9.6 Other Mitigative Considerations

1. Fringe effects (see Table 1) may be caused by clearing construction, wind throw, or exposure. These aspects can be prevented by consultation with the Ministry, licensees, or other agencies. For instance, where clearing to maximum width leaves a strip of mature timber, it may be more appropriate to harvest than leave it to be blown down.

2. Sample plot locations have been shown on the accompanying 1:50 000 maps. No sample plots are impacted by the present alignment, but should the alignment be changed sample plots or research plots may be affected. Liaison must be maintained with the Ministry and licensees.

10.0 CONCLUDING STATEMENTS

The previous sections have been devoted to explaining and analysing the potential impacts of a 287 kV transmission line on the forest resources for two potential routes. Transmission line construction incurs a permanent withdrawal of land from forest lands through which it transgresses. The impact of this incursion is the reduction of productivity from the forest.

There are of course many drains on the forest land base due to roads, parks, developments and other land alienations. These activities, including power transmission, are necessary in reginal development. However, it is critical that the depletion of any nautral resource, and in this case the forest resources, be minimized. Terrace is a community, the economy of which is based on the forest industry. The community presumably wants continual development but at the same time would not want to see its forest land base unduely depleted.

Flat lands of high forest productivity and easy access are limited in the Kalum TSA. It is important therefore that any erosion of these highly productive be limited. The transmission lines cross just such lands so that any measures which minimize the impact on the land must be considered.

This report has shown that route B down the west side of the Kitimat Valley is the shortest (43.07 km), yet the impact on the forest land base in terms of area and loss of annual yield is higher by 725 m^3 per year than route A.

The dollar losses calculated from data provided by the Association of B.C. Professional Foresters shows that the total economic impact is $158,184 per year, less on Route A than Route B.

This report has also considered the potential for double circuiting on either route A or B. Calculations show that double circuiting on route B incurs considerably greater impact than double circuiting on route A, assuming such double circuiting was to take place on the proposed route A. If double circuiting was to be implemented on the right-of-way now occupied by the existing 287 kV line, then impacts on forestry resources would be reduced to a minimum. For these reasons the use of route A is prefered for either single or double circuiting.

Mitigation of impacts on the productive land base are discussed in conventional terms, which assume cleared right-of-way will incur a permanent loss of productive land. It has been suggested that the areas of immature stands on the proposed clearing areas outside the legal right-of-way could be used for forest production. If forest products could be developed from stands managed is a special way on these lands, then certainly the potential area losses shown could be reduced by 83.35 ha and 114.54 ha respectively for route A and B.

The cumulative impacts of losses of land base, yield, and investment are significantly greater on route B, than for route A. The effect of these losses in dollar value to the economy is also correspondingly greater. For these reasons route A is the prefered route for the construction of a 287 kV transmission line.

11.0 PREPARATION OF REPORT

This report is respectfully submitted to B.C. Hydro and Power Authority.

Prepared by: Hugh Hamilton, RPF

Hugh Hamilton Ltd.

Date: April 17, 1990

APPENDIX 1

PERSONS CONTACTED

APPENDIX 1

PERSONS CONTACTED

Ministry of Forests - Kalum Forest District, Terrace

Herb Quast, Operations Manager, Harvesting 638-3290

Ian Bowie, Operations Manager, Forestry

John Perras, Resource Officer, Timber

Skeena Sawmills Ltd., Terrace

Vic Maskulak, Woodlands Manager

Damian Keating, Divisional Forester

Skeena Cellulose Ltd., Terrace

Dan Toumi

Kitimat-Stikine Regional District, Terrace

Andrew Webber

Statistics Canada, Vancouver

Jock Dobie

Association of B.C. Professional Foresters

Candace Laird

APPENDIX 2

DOCUMENTS SUPPLIED

APPENDIX 2

DOCUMENTS SUPPLIED

Ministry of Forests

Kalum Forest District

1. Forest Cover Maps
   - Skeena Supply Block
   - Kitimat Provincial Forest
   - Kitimat Municipal District
2. Kalum TSA
   - Yield Analysis and Options Report
3. Letters
   - November 30, 1989.
   - January 17, 1990.

Skeena Sawmills Ltd.

1. Forest cover maps of North Block of TFL 41.
2. Road Development Map of TFL 41.
3. Excerpt of Management and Working plan regarding Mean Annual Increment (MAI) data for North Block.

Ministry of Forests, Inventory Branch, Victoria

1. Mean Annual Increment (MAI) data for Kalum TSA.

APPENDIX 3

CONIFEROUS AND DECIDUOUS TREE SPECIES

APPENDIX 3

TREE SPECIES OF THE KALUM TSA

Coniferous Tree Species Native to the Study Area and Vicinity

Engelmann spruce	Picea engelmannii (Perry ex Engelm.)
Sitka spruce	Picea sitchensis (Bong.)
Western white spruce	Picea glauca (Moench)
Black spruce	Picea mariana (Mill.)
Amabilis fir	Abies amabilis Dougl.
Subalpine fir	Abies lasiocarpa (Hook.)
Lodgepole pine	Pinus contorta Dougl.
Western hemlock	Tsuga heterophylla (Raf.)
Western red cedar	Thuya plicata Donn
Tamarack	Larix laricina (Du Roi)

Principal Broadleaf Species Native to the Study Area

Black cottonwood	Populus trichocarpa (Torr & Gray)
Balsam poplar	Populus balsamifera (L.)
Trembling aspen	Populus tremuloides (Michx)
White birch	Betula papyrifera (Marsh)

Non-Commercial Tree Species

Mountain alder	Alnus tenuifolia Nutt.
Sitka alder	Alnus situata (Regel)

APPENDIX 4

EXAMPLES OF RIGHT-OF-WAY CROSS SECTIONS

FIGURE 1

SKEENA-KITIMAT 287 kV T/L
TYPICAL RIGHT-OF-WAY CROSS SECTION

ROUTE B - SEPARATE RIGHT-OF-WAY

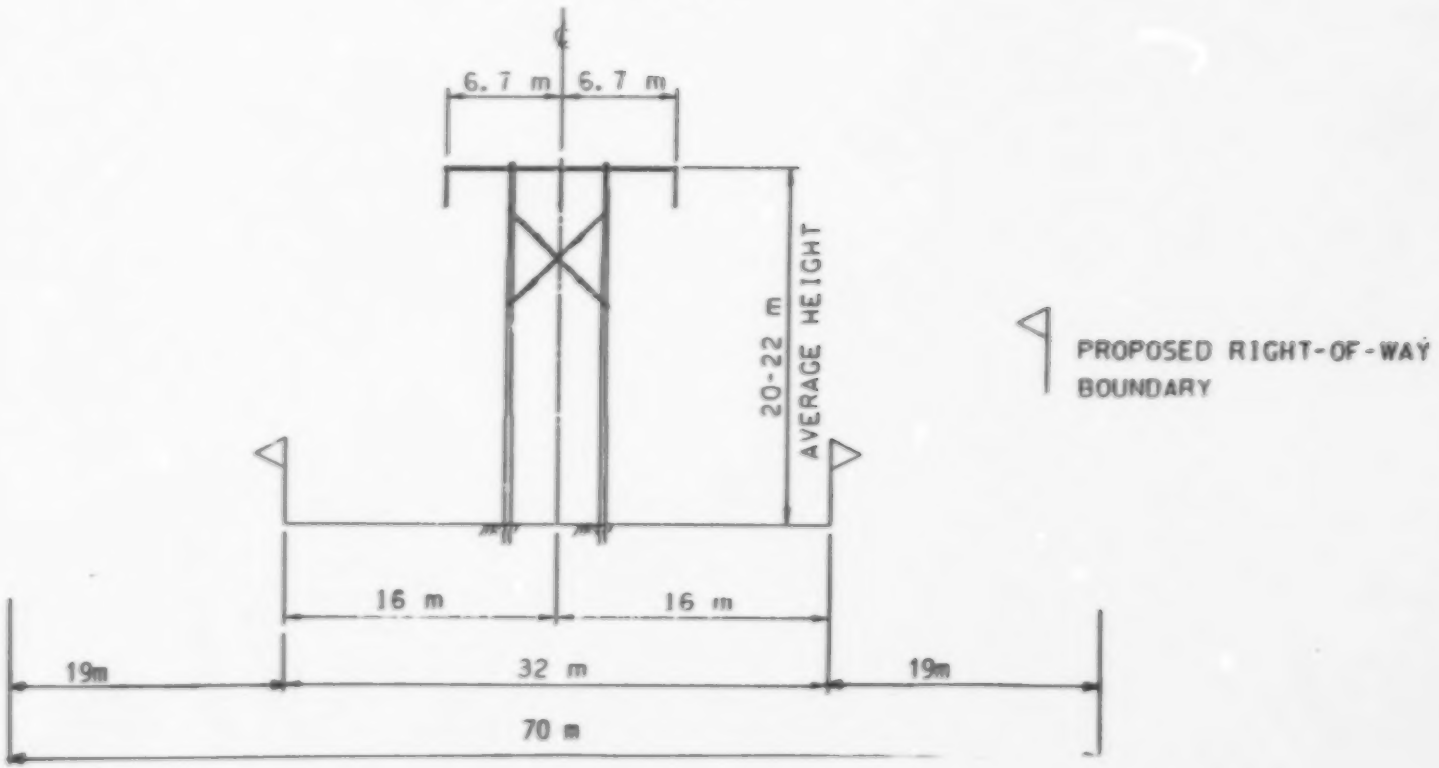


FIGURE 2

SKEENA-KITIMAT 287 kV T/L
TYPICAL RIGHT-OF-WAY CROSS SECTION

ROUTES A & B PARALLEL EXISTING CIRCUIT 2L99
WITHOUT ADJACENT GAS PIPELINE

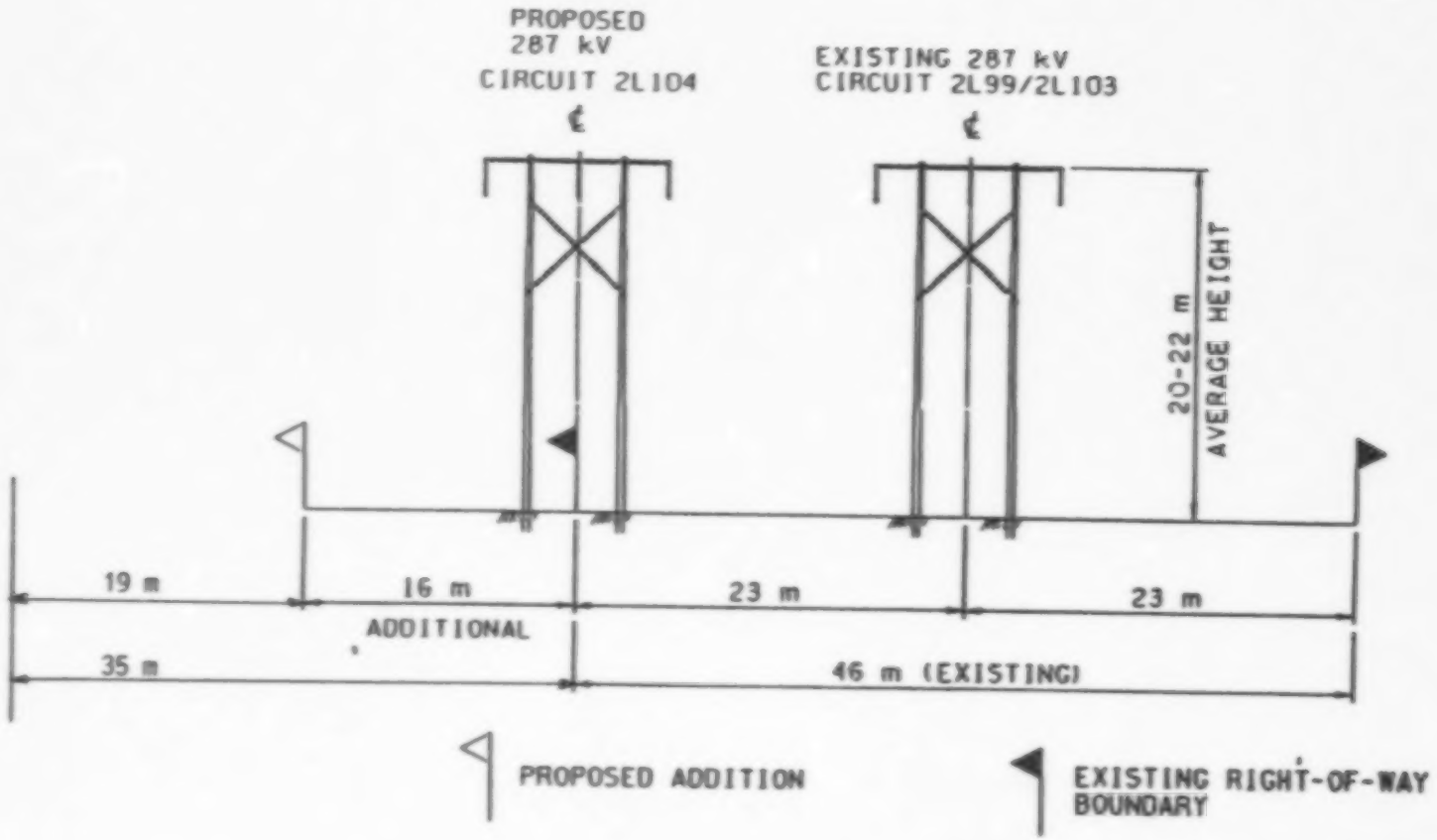
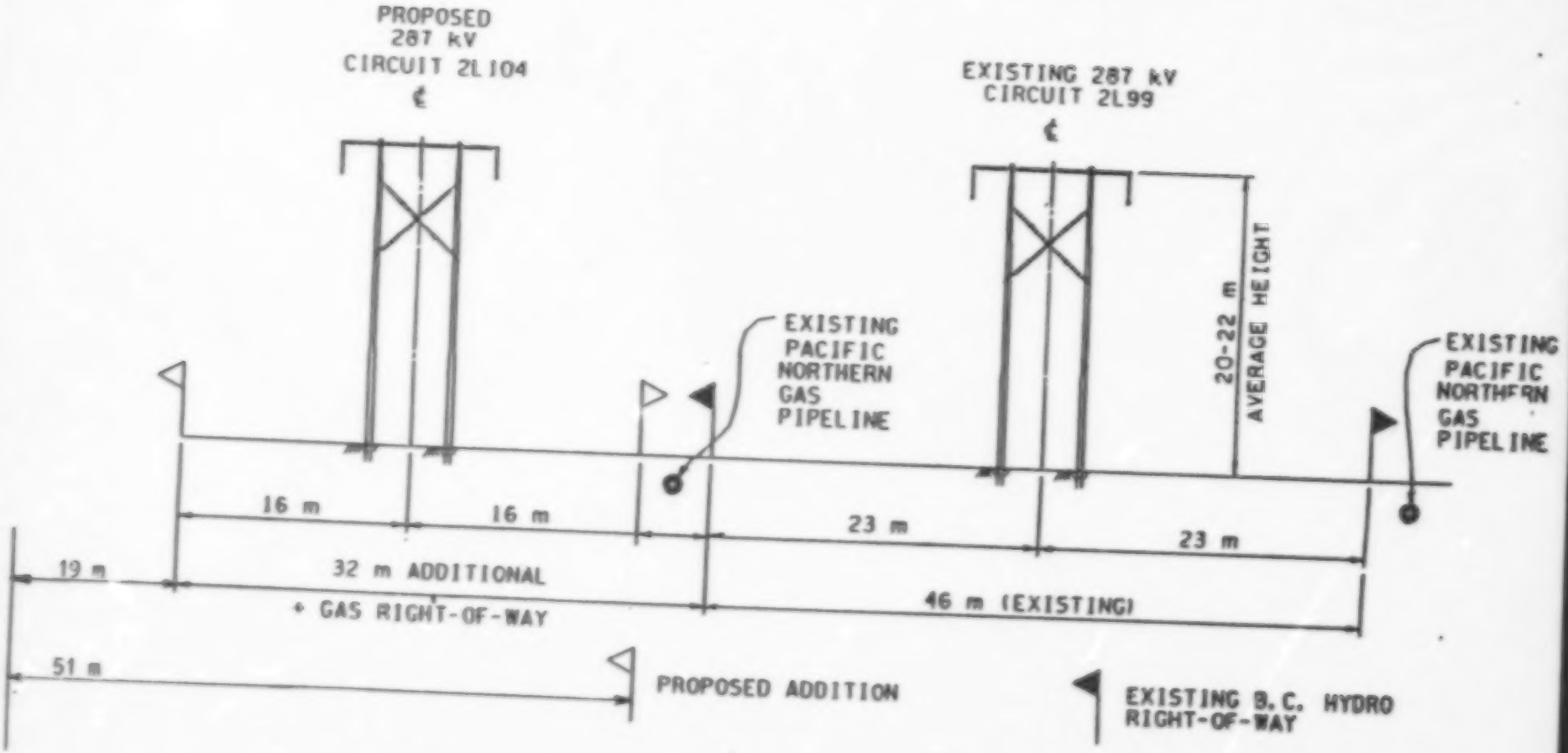


FIGURE 3

SKEENA-KITIMAT 287 kV T/L
TYPICAL RIGHT-OF-WAY CROSS SECTION

WHERE ROUTES A & B PARALLEL EXISTING CIRCUIT 2L99 WITH A GAS PIPELINE BETWEEN CIRCUITS



APPENDIX 5

STATISTICS OF AREA AND YIELD

TABLE A

SUMMARY OF RIGHT-OF-WAY LENGTH BY LAND CLASS

	Total Length	Prod.	NP For	Non For
A	56.33 km	50.11 km	0.50 km	5.72 km
B	43.07 km	41.31 km	0.59 km	1.17 km
AB	8.01 km	7.90 km	-	0.11 km

TABLE B-1

SUMMARY OF RIGHT-OF-WAY AREA
SINGLE CIRCUIT

	Legal Area (ha)					Total Clearing (ha)				
Route	Mat.	Imm	NP	Non For	Total	Mat.	Imm	NP	Non For	Total
A	21.78	81.91	1.41	10.03	115.13	47.25	165.26	2.36	21.40	236.27
B	35.75	96.37	1.87	3.73	137.72	78.26	210.91	4.13	8.19	301.49
AB	0.24	18.94	-	0.35	19.53	0.52	42.04	-	0.77	43.33

TABLE B-2

SUMMARY OF RIGHT-OF-WAY AREA
DOUBLE CIRCUIT

	Legal Area (ha)					Total Clearing (ha)				
Route	Mat.	Imm	NP	Non For	Total	Mat.	Imm	NP	Non For	Total
A	23.17	87.07	1.49	10.65	122.38	48.55	170.35	2.44	22.00	243.34
B	38.01	102.42	2.01	3.98	146.42	80.49	216.91	4.24	8.42	310.06
AB	0.26	20.15	-	0.37	20.78	0.54	42.64	-	0.79	43.97

TABLE C-1

SUMMARY OF RIGHT-OF-WAY YIELD (MAI)
SINGLE CIRCUIT

Route	Legal Area (m^3/yr) G	M	P	L	Total	Total Clearing (m^3/yr) G	M	P	L	Tota
A	114.06	432.12	77.54	1.95	625.67	209.70	878.19	164.57	4.27	1256.7
B	135.99	699.57	35.62	-	871.18	309.58	1593.07	79.12	-	1981.7
AB	6.01	105.28	8.03	-	119.32	13.14	234.01	17.56	-	264.7

TABLE C-2

SUMMARY OF RIGHT-OF-WAY YIELD (MAI)
DOUBLE CIRCUIT

Route	Legal Area (m^3/yr) G	M	P	L	Total	Total Clearing (m^3/yr) G	M	P	L	Tota
A	121.22	459.11	71.41	2.07	653.81	216.80	873.81	167.92	4.40	1262.9
B	144.57	776.07	38.42	-	959.06	306.14	1642.23	81.37	-	2029.7
AB	6.38	111.87	8.54	-	126.79	13.51	236.90	18.07	-	268.4

TABLE D-1

SUMMARY OF MATURE AND IMMATURE STANDS
BY ADMINISTRATIVE UNIT FOR SINGLE CIRCUITS

Route A

	Legal Area		Total Clearing Area	
	Mature	Immature	Mature	Immature
KPF	1.31	40.25	2.38	75.00
STL	1.34	8.03	2.94	17.57
KD MUN	-	8.70	-	19.03
Kalum TSA	7.78	15.61	17.05	34.20
TFL 41	11.35	9.32	24.88	19.46
	21.78	81.91	47.25	165.26

Route B

	Legal Area		Total Clearing Area	
	Mature	Immature	Mature	Immature
KPF	1.15	25.02	2.52	54.74
KD MUN	3.27	4.99	7.14	10.92
Kalum TSA	19.88	19.24	43.54	42.14
TTL 41	11.45	47.12	25.06	103.11
	35.75	96.37	78.26	210.91

Route AB

Legal Area		Total Clearing Area	
Mature	Immature	Mature	Immature
0.24	18.94	0.52	42.04

NOTE: KPF - Kitimat Provincial Forest
STL - Special Timber Licence
KD MUN - Kitimat District Municipality
TFL 41 - Tree Farm Licence 41

TABLE D-2

SUMMARY OF MATURE AND IMMATURE STANDS
BY ADMINISTRATIVE UNIT FOR DOUBLE CIRCUIT

Route A

	Legal Area		Total Clearing Area	
	Mature	Immature	Mature	Immature
KPF	1.39	42.78	2.46	77.53
STL	1.43	8.53	3.02	18.07
KD MUN	-	9.25	-	19.58
Kalum TSA	8.27	16.61	17.50	35.13
TFL 41	12.08	9.90	25.57	20.04
	23.17	87.07	48.55	170.35

Route B

	Legal Area		Total Clearing Area	
	Mature	Immature	Mature	Immature
KPF	1.22	26.58	2.59	56.30
KD MUN	3.47	5.30	7.35	11.23
Kalum TSA	21.15	20.46	44.78	43.33
TFL 41	12.17	50.08	25.77	106.05
	38.01	102.42	80.49	216.91

TABLE E

RIGHT-OF-WAY BY FOREST LAND CLASS
(AREA IN HECTARES)

Legal Area

	Route A		Route B	
	Single	Double	Single	Double
Mature	21.78	23.17	35.75	38.01
Immature	81.91	87.07	96.37	102.42
Non Prod.	1.41	1.49	1.87	2.01
Non Forest	10.03	10.65	3.76	3.98
TOTAL	115.13	122.38	137.72	146.42

Total Clearing Area

	Route A		Route B	
	Single	Double	Single	Double
Mature	47.25	48.55	78.26	80.49
Immature	165.26	170.35	210.91	216.91
Non Prod.	2.36	2.44	4.13	4.24
Non Forest	21.40	22.00	8.19	8.42
TOTAL	236.27	243.34	301.49	210.06

TABLE F-1

AREAS BY FOREST LAND CLASS
FOR ROUTE AB

	Legal	Total
Productive (ha)	19.18	42.56
Non Productive (ha)	-	-
Non Forest (ha)	0.35	0.77
TOTAL (ha)	19.53	43.33

TABLE F-2

YIELD FOR ROUTE AB
m^3/yr

Site Class	Single Circuit Legal	Single Circuit Total	Double Circuit Legal	Double Circuit Total
G	6.01	13.14	6.38	13.51
M	105.28	234.01	111.87	236.90
P	8.03	17.56	8.54	18.07
TOTAL	119.32	264.71	126.79	268.48

APPENDIX 6

POTENTIAL ROAD IMPACTS

APPENDIX 6

POTENTIAL ROAD IMPACTS
(Roads Requiring a Total of 16 m Clearance)

Description	Approx. km
Branch Road	17.2
Branch Road	20.8
Branch Road	22.0
Chist Road	23.6
Kitimat River Road	25.4
Branch 77	26.1
Branch 77	30.1
Branch Road	30.0
Branch Road	30.4
Branch Road	34.5
East 30 Branch	37.5
East 20 Branch	43.5
North Hirsch Branch	46.1
Wedeene Road	52.2

NOTE: Details Provided by
Skeena Sawmills Ltd.

Description	Approx. km
Lakelse Road	6.4
Branch Road	7.2
Branch Road	7.5
Lakilse Road	8.1
Lakilse Road	13.0
Coldwater Road	15.2
Branch 77	18.8
Wedeene	22.0
Wedeene	22.4
Wedeene	24.0
Wedeene	25.0
Branch 1300	26.0
Branch 1300	27.0
Branch 800	27.0
Branch 1322	28.0
Branch 20	28.5
Branch 60	31.9
Branch 500	34.0
Branch 400	35.2
Branch 300	36.3
Branch 200	36.4
Branch 100	37.4
Branch Road	50.3

APPENDIX 7

LETTERS FROM MINISTRY
OF FORESTS

Province of
British Columbia

DISTRICT MANAGER
B.C. Forest Service
200-5220 Keith Avenue
Terrace, B.C.
V8G 1L1

Date: January 17, 1990
File: 870-2-10 (Hydro)
Project #89-792

Hugh Hamilton Ltd.
850 West 15 Street
North Vancouver, B.C.
V7P 1M6

Dear Sir:

Re: B.C. Hydro - Alternatives to Proposal

Node 2-5-6 (West of Williams Cr.)
Contradicts our preference for paralleling the existing line. Will increase visual impacts. Opposed to.

Node 3-4-7
Crosses very productive land in Williams - Sockeye Creeks. Will create island of productive land surrounded by powerline when combined with existing 3-6-7.
Valuable fish and wildlife habitat. The additional line will require additional access, increasing impacts. Opposed to this proposal.

Node 8 (Kitimat River South to Nalbeelah Cr.)
By paralleling the existing line 4-500m to the east will create an isolated strip in excess of 350 ha. This is very productive land. Strongly opposed to.

The remaining alternatives exist along the west side of the Kitimat Valley (Route B) which we are opposed to.

Node 24-25-27 (Little Wedeene)
May isolate up slope areas from the proposed line making them inoperable.

Node 24-26-27 (Little Wedeene)
Exists along a line we are opposed to.

Node 21-23-24 (Big Wedeene East Side)
Proximity to the railway will create a wider inoperable strip than just the width of the transmission line. Object to.

Node 15-14 (Lone Wolf Creek)
Valuable wildlife habitat just north of node 14 (100m). Will impact that area negatively.

Node 14 North (Lone Wolf to Coldwater)
It would appear B.C. Hydro is attempting to hide the powerline behind Iron Mountain, and the knolls north of Lone Wolf and Cecil Creeks. By placing the line in these narrow valleys future logging may be severely constrained.

Cecil Creek and its tributaries are class 1 stream reaches and require special attention.

Object to this alternative.

Yours truly,

G. R. Dodd,
DISTRICT MANAGER

Province of
British Columbia

RECEIVED
DEC - 5 1989
Hugh Hamilton Ltd.

DISTRICT MANAGER
B.C. Forest Service
200-5220 Keith Avenue
Terrace, B.C.
V8G 1L1

November 30, 1989

Our File: 870-2-10 (Hydro)
Project: #89-792

Hugh Hamilton ltd.
850 West 15th Street
North Vancouver, B.C.
V7P 1M6

Attention: E.A.H. Hamilton, R.P.F.

Subject: Skeena-Kitimat 287 Kv Transmission Line

Dear Sir:

Reference is made to our meeting of November 16, 1989 to discuss the proposed access routes for a second transmission line from Kitimat to Terrace.

We have examined the proposals and our comments are outlined below:

1. Although this was not an identified option our first preference would be to re-pole and upgrade the existing line to handle the additional requirements. Forest land is a finite resource. It never increases only decreases in area.

2. Our second choice is to parallel the existing line, Route A in the proposal. To a large extent the aesthetic impacts already exist. Problems associated with moving equipment and conducting forestry operations are identified and will not be unduly compounded by an additional parallel line.

.../2

3. We are opposed to Route B located on the west side of the Kitimat Valley for reasons stated below:

i) Aesthetic concerns at the crossing of the Lakelse River.

ii) Impacting the Small Business Forest Enterprise Program in the Coldwater Creek and Thunderbird areas.

iii) Unstable ground between the Little Wedeene and Wedeene Rivers.

iv) Higher site productivities for those portions located within the Kitimat valley.

v) Additional impacts on moving equipment, access development and forestry operations by creating another corridor.

iv) Additional access roads to be constructed to service the line further reducing the forest land base.

vii) Loss of investment in respect to planting and stand tending activities of sites within the proposed line.

viii) The location goes through and very close to a number of research installations.

Using the M.A.I.'s from T.F.L. 41 is acceptable. We believe these figures are conservative. Unfortunately there is no data to substantiate higher values at this time.

Yours truly,

G.F. Dodd
District Manager

KH/JP/bz

APPENDIX 8

STATISTICS CANADA DATA
AND ABC[illegible] POSITION PAPER
SUMMARY

Statistics Canada
Pacific Region
340-757 West Hastings Street
Vancouver, British Columbia
V6C 3C9

Telephone: 604 666-2649
Facsimile: 604 666-6495

Statistique Canada
Région du Pacifique
340-757, rue Hastings Ouest
Vancouver, Columbie Britannique
V6C 3C9

Téléphone: 604-666-2649
Bélinographe: 604 666-6495

FACSIMILE TRANSMISSION HEADER

DELIVER TO:

Name: HUGH HAMILTON

Firm/ Dept. HUGH HAMILTON & ASSOC.

City: N. VANCOUVER

Phone: 980 5061

Fax: 986 0361

FROM:

Name: Jack DUBIE

Section: STC

Phone: 666 2671

Total Number of Pages (including cover page): 2

Date: FEB 7, 1990 Time: 1325

Delivery: **URGENT** Routine: ✓

COMMENTS

B.C Coast 1986

LOGGING

0.427 person-years per 1000 m^3 logs produced
#56,382 shipments " " " "
$24,771 value-added " " " "

SAWMILLING

1.096 person-years per 1000 m^3 lumber prod
#184,171 shipments " " " "
$76,836 value-added " " " "

7.0 SUMMARY IMPACT STATEMENT - BRITISH COLUMBIA

Forest land grows trees. Trees provide raw material for the largest employer in British Columbia's manufacturing sector. Tree "farming" yields a crop: a harvest of timber which is renewable.

Growing trees for marketable commodities as well as various multiple use benefits requires the commitment of land to wise forest management for a long period of time. Decisions which affect this commitment must consider the economic implications for all of society and not one or more single segments.

One measure of the direct economic worth of operable forest land is its crop value, based on the selling price of end-product commodities shipped from the mill gate. The direct economic benefit of one cubic metre of wood harvested and manufactured by primary processing plants is the average selling price of all commodities produced from this volume, or approximately $\$115/m^3$.

Indirect economic benefits, such as those associated with transporting commodities to border points, are approximately $\$85/m^3$.

Total economic value of direct and indirect benefits arising from timber harvesting and processing is estimated at $\$200/m^3$, averaged over five years.

Thus, one highway truck load of logs would generate $7,000 worth of economic activity. Similarly, one hectare of merchantable timber harvested would result in 400 m^3 x $\$200/m^3$ = $80,000 worth of economic benefit.

The Association of British Columbia Professional Foresters is vitally concerned about alienation of productive forest land from timber harvesting. A 1% reduction in the average operable forest land base will cost the Province $136 million annually in lost economic benefit, calculated as follows:

- Area harvested annually: 170,000 ha
- Reduction - 1% of annual harvest area: 1,700 ha
- Average harvest volume: 400 m^3/ha
- Economic value of direct and indirect benefits: $ 200/m^3
- Total Economic Loss Each Year: 1700 ha x 400 m^3/ha x $200/$m^3$ = $136 million Annually

The ABCPF recommends that all forest land use analyses encompass a wholistic view of the direct and indirect benefits generated by B.C.'s forest crops. It is the Association's position that these benefits be applied in economic assessments of forest land and/or timber. Erosion of the operable forest land base will be to the economic detriment of all British Columbians.

APPENDIX 9

GLOSSARY

APPENDIX 9

GLOSSARY

1. Annual Allowable Cut (AAC)
   The AAC is the annual rate of harvest set for a managed unit. The term also applies to the annual volume that can be cut from a forest licence.

2. Basic Forestry
   Maintenance of the productivity of forest site, restocking of denuded forest lands with commercial tree species within three years of logging for area west of the Coast Range and five years for areas in the Interior, protection against damage by fire, insects and diseases to predetermined standards.

3. Commercial Species
   Tree species which are, or may become, economically harvestable.

4. Environmental Protection Area (EPA)
   An area designated during the forest inventory process as being environmentally sensitive or critically valuable for other uses (e.g. recreation, water, wildlife, etc.) and deserving special attention.

5. Forest Land - as per Section 4 of Forest Act
   Land with a productive capacity suited to the growing of forest crops. Such land may or may not be presently supporting a commercial forest.

6. Intensive Forestry
   Any silvicultural practice beyond the basic level which results in enhanced forest growth. Includes such practices as thinning and fertilizing.

7. Mean Annual Increment
   The average annual growth per hectare on a forest stand.

8. Non-Commercial Forest (NC)
   NC includes stands which are growing on productive land, but have little or no commercial value.

9. Non-Forest
   Those lands which are incapable of producing a forest crop such as swamps, rock, lakes, etc.

10. Non-Merchantable Stands
    Low volume, decadent and deciduous stands.

11. Non-Productive Forest
    Forest Lands capable of supporting forest growth but for various reasons not currently producing forests.

12. Not Satisfactorily Restocked (NSR)
    A forest area that has been more than 75 percent disturbed by fire, logging, etc. and has not been restocked to an acceptable level with commercial species.

13. Old Growth Timber
    Timber which is beyond its peak growing period. Depending on how far beyond its peak growth, it may also be referred to as "mature, overmature, or decadent".

14. Old Temporary Tenure
    A form of timber harvesting licence or tenure dating back 80 years or more. These are being phased out under the current Forest Act.

15. Productive Forest Land
    Land with a productive capacity suited to the growing of forest crops. Such land may or may not now be supporting a commercial forest.

16. Pulp Stands
    Stands unsuitable for the production of sawlogs. Characterized largely by a preponderance of lower volume, decaying balsam and hemlock, and dense lodgepole pine.

17. Region
    There are two uses of this term: The administrative unit which is the first level below the province as a whole; e.g. Prince Rupert Forest Region; also used to define an inventory area or a grouping of compartments.

18. Rotation Age
    The period of years required to establish and grow timber crops to a specified condition of maturity.

19. Second Growth Timber
    The crop of trees in an area which results after timber is removed from an area that has never been logged before. This crop may be planted or it may have grown from natural regeneration.

20. Site Index
    Site is determined from the relationship of total height and age of trees in a stand. It indicates the ability of land to grow timber.

21. Supply Block
    A division of each Timber Supply Area.

22. **Sustained Yield**

The management of forests so as to achieve continuous production of forest products indefinitely.

23. **Timber Supply Area (TSA)**

A specified area of the province created by the Ministry of Forests for purpose of analyzing, planning and managing timber resources. Boundaries have been established considering present and expected population centres, transportation networks, and manufacturing facilities.

MAPS
NOT
FILMED

CARTES
OMISES